

Course Information

Meetings: Tuesdays & Thursdays, 9:25am - 10:40am; MLAB 254

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Course Outline

1. *Fundamentals of Spectroscopy*
 - 1.1 Survey of recent trends in laser spectroscopy Chapters 1-3
 - 1.2 Absorption and emission of light (Vol 1, 4th ed.)
 - 1.3 Spectral line shapes and broadening mechanisms
2. *Optical Spectroscopy*
 - 2.1 Spectrometers Chapter 4
 - 2.2 Interferometers (Vol 1, 4th ed.)
 - 2.3 Detection of optical radiation
3. *Lasers and Spectroscopic Light Sources*
 - 3.1 Advantages of lasers in spectroscopy Chapter 5
 - 3.2 Fixed frequency lasers (Vol 1, 4th ed.)
 - 3.3 Tunable coherent light sources
 - 3.4 Nonlinear frequency conversion
 - 3.5 Optical beams and resonators
4. *Laser Spectroscopy*
 - 4.1 Basic principles Chapters 1-9
 - 4.2 Precision spectroscopy: fundamental measurements (Vol 2, 4th ed.)
 - 4.3 Doppler limited techniques
 - 4.4 High resolution laser spectroscopy
 - 4.5 Time resolved laser spectroscopy
 - 4.6 Laser Raman spectroscopy
5. *Applications of Laser Spectroscopy*
 - 5.1 Laser induced chemical processes Chapter 10
 - 5.2 Laser isotope separation (Vol 2, 4th ed.)
 - 5.3 Laser monitoring of the atmosphere
 - 5.4 Laser spectroscopy in biology and medicine
 - 5.5 Technical applications (e.g., combustion)

ELEC 568 Grading Guidelines

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| I. | Classroom Seminar (Nov./Dec. 2014) <ul style="list-style-type: none">• Choice of Research Topic• Detailed Preparation• Report Outline• Timing and preparation of. Presentation• Oral Presentation• Final Report (3 pages) | 50% |
| II. | Presentations of a recent laser spectroscopy oriented research paper (Oct. 14) <ul style="list-style-type: none">• Choice of Research Topic• Preparation of Presentation• Report Outline• Timing and preparation of presentation• Oral presentation | 30% |
| III. | Classroom Participation and discussion of laser spectroscopy problems | 15% |
| IV. | Attendance of Spectroscopy Oriented Rice Colloquia & Lectures | 5% |

The class grade is based on attendance and class contribution in the form of the two presentations, attendance at colloquia and the final paper. Please be attentive, no cell phones (turn them off), texting, & no Facebook during class.

Rice Honor Code

All students will be held to the standards of the Rice Honor Code. Consult the Honor System Handbook at <http://honor.rice.edu/honor-system-handbook/> if you have any questions.

Disability Support Services

Students requiring adjustments or accommodations with a documented disability or condition are encouraged to speak to the instructor within the first two weeks of classes and to contact the Disability Support Services Office in the Allen Center.

Books on Photonics, Optoelectronics, Optics and Laser Spectroscopy

D.L. Adams, *Applied Laser Spectroscopy* (1992).

P.W. Atkins and C. Trapp, *Physical Chemistry*, Fifth Edition (Freeman, 1994).

C.N. Banwell, *Molecular Spectroscopy*, Fourth Edition (McGraw Hill, 1994).

P. Bernath, *Spectra of Atoms and Molecules* (Oxford, 1995).

E. Boeker and R. V. Grandelle, *Environmental Physic* (John Wiley and Sons, 1995).

B.H. Bransden, *Physics of Atoms and Molecules* (Longman/J. Wiley).

J. Buus, M. C. Amann and D. J. Blumenthal, *tunable Laser Diodes and related Optical Sources*, 2nd Edition (IEEE Press, 2005).

R.F. Byer, *Tunable Solid State Lasers for Remote Sensing* (Springer-Verlag, 1985).

R. Chang, *Basic Principles of Spectroscopy* (McGraw-Hill, 1971).

C. Cohen-Tanoudji, *Atom-Photon Interactions* (Wiley, 1992).

A. Corney, *Atomic and Laser Spectroscopy* (Oxford, 1977).

W. Demtröder, *Laser Spectroscopy: Basic Concepts and Instrumentation*, 4th Edition (Springer Verlag, 2008)

M. Ducloy, E. Giacobino, and G. Camy, *Laser Spectroscopy* (World Scientific Publishing, 1992).

H. Figger, D. Meschede and C. Zimmermann, *Laser Physics At The Limits* (Springer, 2002).

F. de Fornel, *Evanescent Waves From Newtonian Optics to Atomic Optics* (Springer, 2001).

J. Goodman, *Introduction to Fourier Optics*, 3rd Edition (Roberts and Co., 2005).

Haken and Wolf, *Physics of Atoms and Quanta*, Fourth Edition (Springer, 1994).

D. E. Heard, *Atmospheric Measurement* (Blackwell Publishing, 2006).

P. Hering, J. P. Lay and S. Stry, *Laser in Environmental and Life Sciences* (Springer, 2004)

G. Herzberg, *The Spectra and Structures of Simple Free Radicals: An Introduction to Molecular Spectroscopy* (Herzberg, 1971).

E. Hirota, *High-Resolution Spectroscopy of Transient Molecules* (Springer-Verlag, 1985).

P. C. D. Hobbes, *Building Electro-Optical Systems: Making It All Work*, 2nd Edition (John Wiley and Sons, 2009).

J. M. Hollas, *Hi resolution Spectroscopy*, 2nd Edition (John Wiley and Sons, 1998).

D.S. Kliger, *Ultrasensitive Laser Spectroscopy* (Academic Press, 1983).

W. Koechner, *Solid-State Laser Engineering*, 5th Edition (Springer, 1999).

E. Kress-Rogers, *Handbook of Biosensors and Electronic Noses: Medicine, Food, and the Environment* (CRC Press, 1997).

K. J. Kuhn, *Laser Engineering* (Prentice Hall, 1998).

W. Lauterborn, et al., *Coherent Optics* (Springer-verlag, 1993).

V.S. Letokhov, *Laser Spectroscopy of Highly Vibrationally Excited Molecules* (IOP Publisher, UK, 1989).

M. Levenson, *Introduction to Nonlinear Laser Spectroscopy* (Academic Press, 1982).

G. Marowsky, *Coherent Raman Spectroscopy* (Springer-Verlag, 1992).

J. L. McHale, *Molecular Spectroscopy*, (Prentice Hall, 1999).

R. Measures, *Laser Remote Sensing* (Krieger, 1992).

E.R. Menzel, *Laser Spectroscopy: Techniques and Applications* (Marcel-Dekker, 1995).

R. Menzel, *Photonics: Linear and Nonlinear Interactions of Laser Light and Matter* (Springer, 2001)

S. Parker, ed., *Optics Source Book* (McGraw-Hill, 1988).

P. N. Prasad, *Introduction to Biophotonics* (John Wiley and Sons, 2003).

J. Seinfeld and S. Pandis, *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd Edition (John Wiley and Sons, 2006).

M. Sigrist, ed., *Air Monitoring by Spectroscopic Techniques* (Wiley and Sons, 1994).

R.E. Simon, *Electro-Optics Handbook* (RCA, 1974).

R. Stebbings and F. Dunning, eds., *Rydberg States of Atoms and Molecules* (Cambridge, 1983).

S. Steinhilber, *Foundations of Laser Spectroscopy* (Wiley and Sons, 1984).

S. Svanberg, *Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications* (4th Edition, Springer-Verlag, 2004).

A. Thorne, U. Litzen and S. Johansson, *Spectrophysics: Principals and Applications* (Springer, 1999)

J. Verdeyen, *Laser Electronics, Third Edition* (Prentice Hall, 1995).

D.F. Walls and G.J. Milburn, *Quantum Optics* (Springer-Verlag, 1994).

R. Waynant and M. Ediger, *Electro-Optics Handbook* (McGraw-Hill, 1994).

M. Weissbluth, *Atoms and Molecules* (Academic Press, 1978).

E. Wolf and M. Born. *Principals of Optics*, 7th Edition (Cambridge University Press, 1999).

A. Yariv, *Optical Electronics*, 4th Edition (Holt, Rinehart and Winston 1991).

A. Yariv, *Photonics: Optical Electronics in Modern Communications*, 6th edition (Oxford University Press, 2006)

M. Young, *Optics and Lasers*, 5th Edition (Springer-Verlag, 2000).

Prepared by F.K. Tittel & Surbhi Lal, August 26, 2013